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Civil & Commercial Applications Project (CCAP): QuickBird Image Interpretability (NIIRS) Evaluation Results

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CCAP Mission

- CCAP is the NIMA process to assess the utility of emerging civil and commercial remote sensing systems
- DoD Directive 5105.60 states that NIMA shall:
 - Assess the applicability of evolving commercial capabilities to meet imagery and geospatial information needs of the Department of Defense and the Intelligence Community
- CCAP partners include USGS and NASA-Stennis:
 - JACIE (Joint Agency Commercial Imagery Evaluation) Team
 - Space Act Agreement
- Elements of the evaluations:
 - Image interpretation for intelligence, military, and civil applications
 - Feature extraction for mapping
 - Geopositional accuracy
 - Radiometric fidelity



Study Objective

- Determine the National Imagery Interpretability Rating Scale (NIIRS) of the following QuickBird imagery products:
 - Panchromatic (Visible NIIRS)
 - Multispectral (Spectral NIIRS)
 - Pan-Sharpened Multispectral (Spectral NIIRS)



Approach

- 10 Imagery Analysts (IAs)
- 53 Images; 28 unique geographic locations
 - 28 Pan (Basic 1B)
 - 10 MSI (Basic 1B), and
 - 15 Pan Sharpened MSI (Standard 2A)
 - All images at near-nadir collection geometry
 - Pan and Pan-Sharpened: GSD between 0.62 and 0.7 meters (24.4 – 27.6 inches)
 - MSI: GSD = 2.54 meters (100 inches)
 - Resampling kernel: Nearest Neighbor



Approach, cont.

- One to five sub-scenes chipped from each image
 - “Chip” size ranged from 2048^2 to 6144^2 pixels, depending on the product
 - Total of 213 sub-scenes
- NIIRS ratings
 - Images displayed on certified and calibrated, non-destructive softcopy displays



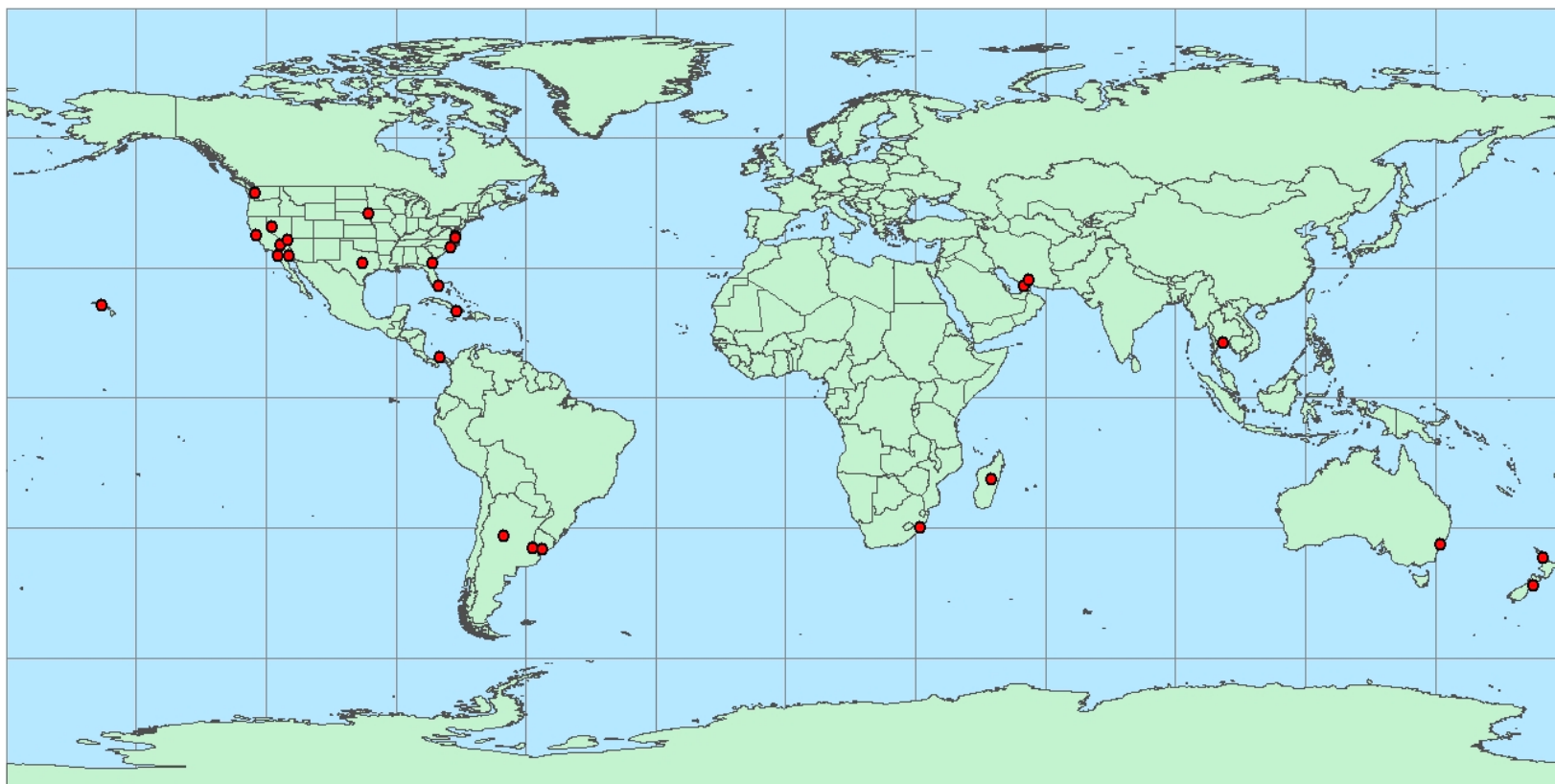
Scenes by Product Type

Site Location	Pan	Pan Sharpened	True/False Color
Antananarivo, MA	Basic1B	Standard2A	Basic1B
Auckland, NZ	Basic1B		Basic1B
Abu Musa, TC	Basic1B	Standard2A	Basic1B
Buenos Aires, AR	Basic1B		Basic1B
Bandar Abbas, IR	Basic1B		Basic1B
Camp Lejeune, NC	Basic1B		Basic1B
Christchurch, NZ	Basic1B	Standard2A	Basic1B
Colon, PM	Basic1B		Basic1B
Durban, SF	Basic1B	Standard2A	Basic1B
Ft. Irwin, CA	Basic1B	Standard2A	Basic1B
Fallon, NV	Basic1B	Standard2A	Basic1B
Ft. Hood, TX	Basic1B		Basic1B
Ft. Lewis, WA	Basic1B		Basic1B
Hickam, HI	Basic1B		Basic1B
Langley AFB, VA	Basic1B	Standard2A	Basic1B
Miami, FL	Basic1B	Standard2A	Basic1B
Montevideo, UY	Basic1B		Basic1B
Nellis, NV	Basic1B	Standard2A	Basic1B
Norfolk, VA	Basic1B	Standard2A	Basic1B
Sydney, AS	Basic1B		Basic1B
San Diego, CA	Basic1B	Standard2A	Basic1B
Santiago De Cuba	Basic1B	Standard2A	Basic1B
St. Simons, GA	Basic1B		Basic1B
Souix City, IA	Basic1B	Standard2A	Basic1B
Sunnyvale, CA	Basic1B	Standard2A	Basic1B
Utapao, TH	Basic1B		Basic1B
Villa De Lores,	Basic1B	Standard2A	Basic1B
Yuma, AZ	Basic1B		Basic1B



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Scene Locations



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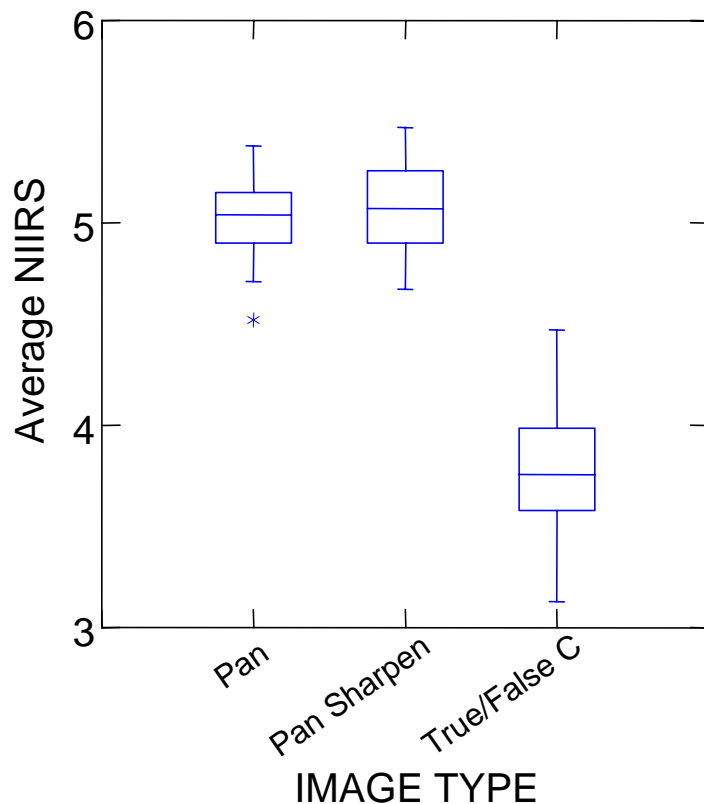
Outlier Analysis

- 3 IA's incorrectly used an outdated version of the MS NIIRS scale. The MSI and Pan-Sharpened data results for these IAs were removed from the analysis.
- A statistical analysis of individual IA NIIRS ratings did not identify any additional NIIRS ratings as outliers.
- Thus, all IA data except for the those identified in the first bullet were included in the analysis.



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Average NIIRS by Product



Type	Avg NIIRS
Pan	5.04
Pan-Sharpended	5.07*
MSI	3.77*

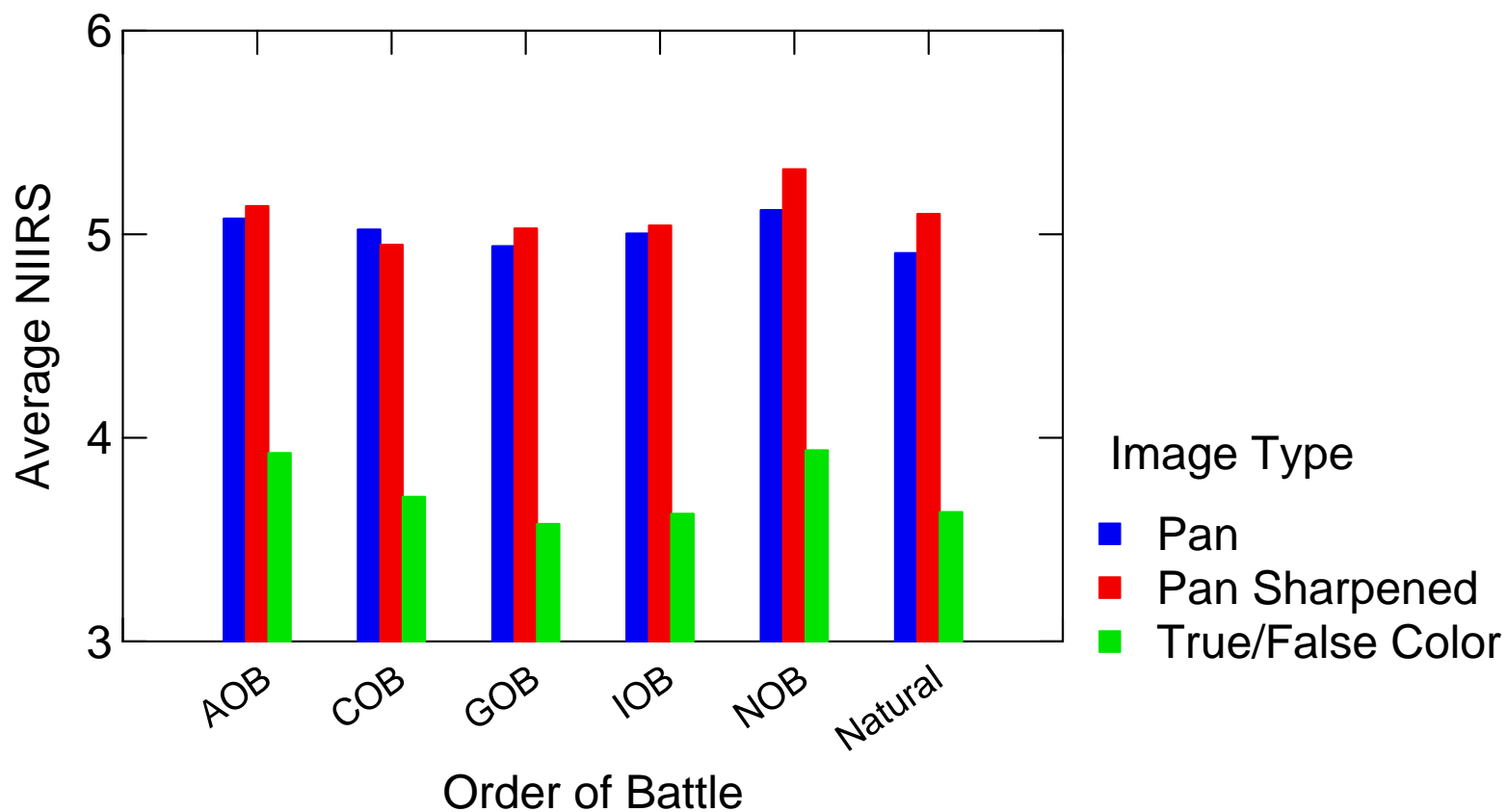
*Using the MS NIIRS Scale

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NIIRS by Order of Battle



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Conclusions

- QuickBird Panchromatic imagery will satisfy NIIRS 5 requirements about half the time. The other half will satisfy high NIIRS 4 requirements
 - Average NIIRS a quarter of a unit better than that determined in the earlier evaluation (December 2002)
 - Assumes near-nadir collection geometry
 - **Visible NIIRS 5** criteria
 - Distinguish between a MIDAS and a CANDID by the presence of refueling equipment (e.g., pedestal and wing pod).
 - Identify TOP STEER or TOP SAIL air surveillance radar on KIROV-, SOVREMENNY-, KIEV-, SLAVA-, MOSKVA-, KARA-, or KRESTA-II-class vessels.
 - Identify radar as vehicle-mounted or trailer-mounted.
 - Distinguish between SS-25 mobile missile TEL and Missile Support Vans (MSVs) in a known support base, when not covered by camouflage .
 - Identify individual rail cars by type (e.g., gondola, flat, box) and/or locomotives by type (e.g., steam, diesel).
 - Identify, by type, deployed tactical SSM systems (e.g., FROG, SS-21, SCUD).



Conclusions, cont.

- QuickBird pan-sharpened MS imagery will satisfy NIIRS 5 requirements about half the time. The other half will satisfy high NIIRS 4 requirements.
 - Assumes near nadir collection geometry
 - **MS NIIRS 5** criteria
 - Detect individual trees with indications of vegetation stress.
 - Identify color of unfurled sails on sailboats (20 to 30 feet in length).
 - Distinguish between military and civilian helicopters paint schemes.
 - Identify large ground forces equipment by type (e.g., tanks, SP-guns, ARVs).
 - Detect foxholes by ring of spoil outlining hole.
 - Detect the presence of sailors in formation on the deck of a large combatant during parade/review.
 - Identify colors of stripes/deck markings on major surface combatants.



Conclusion, cont.

- QuickBird MSI imagery will satisfy NIIRS 3 requirements and sometimes NIIRS 4 requirements
 - Assumes near-nadir collection geometry
 - **MS NIIRS 3** criteria
 - Distinguish between fallow and abandoned fields.
 - Detect effluent discharge into water from industrial facility.
 - Differentiate between open pit coal mine and a limestone quarry.
 - Identify large cargo aircraft as military or commercial based on paint color and/or scheme.
 - Detect rows of vehicles in a parking area.
 - Identify beach terrain suitable for amphibious landing operations.
 - **MS NIIRS 4** criteria
 - Detect vegetation stress/aging in narcotics crops in reported eradication area.
 - Identify tennis court as being composed of grass, clay or rubber/composite.



Conclusions, cont.

– MS NIIRS 4 criteria (cont)

- Detect CC&D efforts (cut vegetation camouflage netting) at suspected coca processing facilities.
- Identify azimuth markings (numbers) on runway.
- Detect tanks and SP-guns in revetted positions.
- Detect blast marks from mobile or silo based ICBM launches on concrete.
- Detect presence of Sea-Land containers on a ship's deck.
- Distinguish between coal and sand loaded on dumb barge.



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